HOVENWEEP AND NATURAL BRIDGES NATIONAL MONUMENTS
RESEARCH SUMMARY 2009

1) Study Title: Soil Survey of Hovenweep National Monument, Utah
Permit No.: HOVE-2009-SCI-0001
Principal Investigator: Victor Parslow
Purpose of Scientific Study: To provide an updated soil and ecological site inventory for Hovenweep National Monument that meets National Cooperative Soil Survey (NCSS) standards and park management and planning needs.
Findings/Accomplishments for 2009: 1. Soil Survey Activities: Soil survey activities were conducted in Hovenweep NM during 2009. Soil descriptions and plant inventory data was recorded. Soil samples were collected from 30 locations. These samples have been catalogued, and are stored in the Richfield USDA Service Center. Archaeological activities: All cultural resources were successfully avoided. No cultural material was unearthed during the course of soil sample collection.

2) Study Title: Taxonomy and natural history of the Rhaphidiphoridae and Stenopelmatidae (Orthoptera) of the Colorado Plateau
Permit No.: HOVE-2009-SCI-0003
Principal Investigator: Tim Graham
Purpose of Scientific Study: The taxonomy of the Orthopteran family Rhaphidiphoridae (camel crickets) is being revised. A number of species of Ceuthophilus from the Colorado Plateau were originally named from one or a few specimens collected in the early 1900's. Additional specimens are needed to re-evaluate the validity of some species designations. In addition, the taxonomy of other Rhaphidiphorids (e.g., the sand treaders Ammobaenetes Daihinibaenetes and Daihinoides) is in flux with suspected undescribed species and species' ranges unknown.
Work proposed in Hovenweep NM would involve limited collecting via the use of rolled oat trails and small pitfall traps (< 20 cm depth) in sand dune and sandy grassland areas, providing new specimens for the taxonomic work. Habitat characteristics of each collection will be described in detail and behavioral observations will be made when possible. Essentially the same situation exists with the Stenopelmatidae (Jerusalem crickets). Work is being conducted on drumming by Jerusalem crickets that appears to be involved in mating activities and thus may indicate different species even when distinguishing morphological characters have not been found. The same collecting activities will provide Jerusalem crickets as well as the camel crickets.
Findings/Accomplishments for 2009: There was no activity on this permit.

3) Study Title: Soil Survey of Natural Bridges National Monument, Utah
Permit No.: NABR-2009-SCI-0002
Principal Investigator: Victor Parslow
Purpose of Scientific Study: To provide an updated soil and ecological site inventory for Natural Bridges National Monument (NABR), that meets National Cooperative Soil Survey (NCSS) standards and park management and planning needs. The existing soil survey was conducted in the late 1970s and the early 1980s as part of the San Juan County, Utah, Central Part soil survey. This inventory was primarily designed as a tool for use in managing grazing lands and has been found to be too general to be useful in managing the park. Information is insufficient to model

salt movement, mitigate visitor impacts, identify and protect habitat of Threatened and Endangered species, and other park responsibilities. In 2003, reprensentatives of the National Park Service approached the Natural Resources Conservation Service to update the existing soil surveys within Arches and Canyonlands National Parks and Natural Bridges and Hovenweep National Monuments. The Plan of Work and contracted were approved in 2004. This application is seeking permission to carry out the field work necessary to complete the contract.
Findings/Accomplishments for 2009: Draft soil survey report was produced this year. No field activities were conducted.

4) Study Title: Phylogeny and Evolutionary History of *Anticlea vaginata* Rydb. (Melanthiaceae): A Hanging Garden Endemic
Permit No.: NABR-2009-SCI-0001
Principal Investigator: Tina Ayers
Purpose of Scientific Study: Sheathed Death Camas, *Anticlea vaginata* Rydb. (Liliales: Melanthiaceae) is a rare hanging garden endemic species. This research will add to the body of knowledge about Colorado Plateau hanging garden endemic plant species, assist with the ongoing endeavor to resolve the complicated taxonomy of the genus *Anticlea*, and assist agencies in future land management decisions involving this species. Knowledge of genetic diversity within populations will suggest which populations are particularly important to protect, and knowledge of gene flow will indicate what hanging gardens, if any, are interacting as subpopulations and which are completely isolated.
This research will address the following questions:
Is *Anticlea vaginata* a distinct taxon?
What is the most likely geographic and biological origin for *Anticlea vaginata*?
Is there gene flow between isolated populations of Anticlea vaginata and between *A. vaginata* and *Anticlea elegans*, or does there appear to be continuing diversification?
Which populations of *Anticlea vaginata* exhibit the highest levels of genetic diversity, recommending them for future conservation?
What pollinators are visiting this species and which ones seem to be the most important to its fecundity?
Findings/Accomplishments for 2009: Sheathed Death Camas, *Anticlea vaginata* Rydb. (Liliales: Melanthiaceae) is a rare, hanging garden endemic plant species. *Anticlea vaginata* occurs from Dinosaur National Monument south to Arches NP, Canyonlands NP, Natural Bridges NM, and Glen Canyon NRA. There is also one population in Zion NP, one in Grand Canyon NP, and a few in northeastern Arizona on the Navajo Reservation. Very little research has been conducted on this unique species. In order address *A. vaginata*'s validity as a species, amounts of gene flow between populations, and levels of genetic diversity, a combination of molecular data, physical characteristics, and life history traits are being analyzed. For two populations, one leaf from each of 15 individuals was collected for genetic analysis. One entire plant was collected from each of the included populations to be a voucher specimen and to be included in analyses of physical characteristics. Genetic and morphological analyses are in progress. Identifying whether or not *A. vaginata* is a good species, knowing its levels of genetic diversity and gene flow, and understanding its basic life history traits will all assist in its management.

5) Study Title: NCPN Integrated Riparian Monitoring in Natural Bridges National Monument
Permit No.: NABR-2009-SCI-0004
Principal Investigator: I&M NCPN

Purpose of Scientific Study: The National Park Service's Inventory and Monitoring Program (NPS I&M), in collaboration with 32 monitoring networks, are charged with monitoring natural resources. Vital signs represent a select set of physical, chemical and biological elements and processed of park ecosystems that are chosen to represent the overall health and condition of a park's resources. Together, the Northern and Southern Colorado plateau Networks (NCPN and SCPN) have developed conceptual models of key ecosystems and identified an integrated set of vital signs for tracking resource conditions at 35 NPS units within or near the Colorado Plateau (Thomas et al. 2004, O'Dell et al. 2005). Riparian systems are a high priority vital sign for the NCPN (O'Dell et al. 2005). Riparian systems are disproportionately high in biodiversity relative to their spatial extent due to the year-round or at least frequent availability of water. In turn, healthy and natural riparian systems serve as a predictable source of water, and function to maintain the natural diversity of riparian-adapted plants and animals across the Colorado Plateau region. Various dynamics interact to influence riparian systems. Ground-water levels, flood disturbance intensity and frequency, plant population, dynamics, and even upland conditions and dynamics collectively interact to shape the in-stream conditions and vegetative features of a riparian zone. Monitoring the status and trends in representative attributes and effects of an array of patterns and processes is an overarching goal of the NCPN Integrated Riparian Monitoring effort. This effort is intended to provide park managers with information on the variability of riparian systems, and to provide early warning of system degradation. In the latter case, monitoring information can be used to determine the potential for mitigating actions, and where such actions are implemented, monitoring efforts can contribute to understanding the effects of these actions. The full set of procedures for the NCPN Integrated Riparian Monitoring effort needs field testing for feasibility and refinement. However, the basic framework for selecting sites, for establishing stream-reach plots, for monitoring riparian vegetation, for surveying geomorphic surfaces across the riparian zone, and for measuring shallow groundwater levels and surface water stage is in place. These procedures can be implemented at this time as pilot implementation of the Integrated Riparian protocol. Pilot implementation is proposed for Armstrong Canyon in NABR. Specific objectives of the overall riparian monitoring effort are to determine the status and trends in:
1) the areal extent, cover, species composition and structure of riparian vegetation
2) exotic plant species
3) channel morphology of surveyed cross sections and the channel thalweg
4) floodplain ground-water levels and stream flow/discharge
Procedures for riparian monitoring incorporated pieces of the USGS Water Quality Assessment Program (Moulton et al. 2002) and EMAP procedures (Kaufmann et al. 1999) and were initially developed by Scott and Reynolds (draft). Further refinement has been completed by NCPN staff and by Steve Monroe and Ellen Soles of the SCPN.
Findings/Accomplishments for 2009: No activity was conducted this report year.

6) Study Title: An Investigation of North American Monsoon Variability using Instrumental and Tree-Ring Data
Permit No.: NABR-2009-SCI-0005
Principal Investigator: Daniel Griffin
Purpose of Scientific Study: The goal of this National Science Foundation-funded project is to investigate the behavior of the North American Monsoon (NAM) as a critical source of moisture for northwestern Mexico and the U.S. Southwest. Specifically, the researchers will design and apply new techniques to develop a tree-ring network that targets long-term NAM variability in the US Southwest.

Capitalizing on 30-40 existing tree-ring collections, the researchers will return to the original sampling sites to update the collections
to the calendar year 2009. Re-analysis of these tree-ring collections will develop partial ring-width indices (earlywood and latewood)
to reconstruct and examine the long-term variability of monsoon season precipitation, its relation with winter precipitation and
widespread droughts in western North America, and to ocean/atmosphere circulation in the Pacific Ocean. The tree-ring data will also be combined with downscaled general circulation model (GCM) simulations to help understand the spatial and temporal
characteristics of the NAM in the southwestern U.S. over the last few centuries as a means of providing a baseline for assessing both
the instrumental records and the skill of downscaled GCMs in replicating natural variability.
We hope to update tree-ring collections at federally managed parks as part of this study, including the Mesa Verde, Guadalupe
Mountains, and Bryce Canyon National Parks, as well as the Natural Bridges, Chiricahua, and Walnut Canyon National Monuments.
These properties have proven critical to tree-ring research over the past century, serving as unique refugia for old-growth Douglas-fir
forests. The tree-ring chronologies developed at these sites are among the most important in the US Southwest, and updating the
existing tree-ring collection to the calendar year 2009 will allow the to be included in our detailed analyses.
We request permission to re-visit the tree-ring site at White Canyon in order to non-destructively sample increment cores from 20 to
30 living Douglas-fir trees. This is one of the northernmost sites in our proposed tree-ring network
(http://monsoon.ltrr.arizona.edu/sites.html), and we sincerely believe it to be critical for examining variability around the northern
extent of the monsoon in the Southwestern United States.
The broader impacts of this project include a strong educational mentoring portion and an equally strong intellectual portion. The
research will help support graduate and undergraduate student involvement in a cutting-edge paleoclimate project whose goal is to use
tree-rings science to better inform regional water resource planners. It is our hope that the results of this study, specifically a more
detailed seasonal climate history, would be of interpretive and intellectual relevance to visitors and other research projects being
conducted in the Natural Bridges National Monument. Upon permission from the park, the specimens would be accessioned under the
NPS system and permanently archived at the University of Arizona Laboratory of Tree-Ring Research.
Findings/Accomplishments for 2009: In July 2009, Laboratory of Tree-Ring Research (LTRR) researchers Daniel Griffin, Connie Woodhouse, Mark Losleben, and Victor Major visited Natural Bridges National Monument to collect new tree-ring specimens from the original sampling site in White Canyon where Jeff Dean of the LTRR had made tree-ring collections in 1972 and 1989. Off trail, just below the upper level bluff of White Canyon, two increment cores were non-destructively sampled from each of nineteen living Douglas-fir (Pseudotsuga menziesii) trees.
Meeting the stipulations prescribed by the NPS, no more than ten percent of trees in a given stand were sampled. Back at the LTRR in the fall of 2009, these specimens were inventoried and prepared (mounted and sanded) for microscope analysis and

cross dating using standard tree-ring techniques. Also in 2009, the archived tree-ring collections from the site was obtained from the LTRR archives and prepared for earlywood and latewood measurement.
In 2010, the collections made in 2009 at Natural Bridges National Monument will be analyzed and cross-dated using the methods of dendrochronology. Tree-ring specimens from both the new and archived collections will be measured for earlywood- and latewoodwidth. The newly completed chronology from White Canyon will include over 100 radii from approximately 50 trees and will extend from 1347-2008. In 2011, this chronology, along with the other 50 or so in the network, will be used in analyses geared toward reconstructing spatiotemporal variability in monsoon precipitation across the region, and a final report on the projects findings will be prepared for the NPS.

7) Study Title: Taxonomy and natural history of the Rhaphidiphoridae and Stenopelmatidae (Orthoptera) of the Colorado Plateau
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Principal Investigator: Tim Graham
Purpose of Scientific Study: The taxonomy of the Orthopteran family Rhaphidiphoridae (camel crickets) is being revised. A number of species of Ceuthophilus from the Colorado Plateau were originally named from one or a few specimens collected in the early 1900's. Additional specimens are needed to re-evaluate the validity of some species designations. In addition, the taxonomy of other Rhaphidiphorids (e.g., the sand treaders Ammobaenetes Daihinibaenetes and Daihinoides) is in flux with suspected undescribed species and species' ranges unknown.
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Findings/Accomplishments for 2009: There was no activity on this permit.